

# High temperature superconductor bolometers for spectral imaging of cold planetary objects

Completed Technology Project (2015 - 2018)



## Project Introduction

The 2013 Planetary Science Decadal Survey recommends a number of missions that require thermal imaging and compositional analysis the surfaces of cold bodies to gain understanding about the origins and evolution of the solar system and possible habitable climates therein. In response, we propose development of superconducting bolometer arrays for the focal planes of thermal imagers. Working in combination with a wavelength dispersive element such as an Offner grating or a FTIR spectrometer, these arrays are sensitive enough to provide thermal images with hyperspectral wavelength resolution of each spatial pixel of objects such as the icy moons of Jupiter and the cold primitive bodies of the outer solar system. This hyperspectral thermal imager would serve as a significant advancement over standard thermal imagers and would complement information gathered from other spectrometers that function at shorter wavelengths. The bolometers are fabricated out of the high temperature superconductor YBCO, which is patterned to form kinetic inductance devices (KIDs) and suspended on thin membranes so that they function as bolometers. These devices are multiplexed using microwave readout to achieve arrays of thousands of bolometers. The superconducting bolometers operate at 50 K to offer much higher sensitivity compared to standard radiometers operating at 300 K, but they do not require the complex, expensive coolers that are necessary for detectors made of low temperature superconductors.

## Anticipated Benefits

Provides better signal-to-noise ratios than currently-deployed broadband infrared detectors for planetary science.



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## Table of Contents

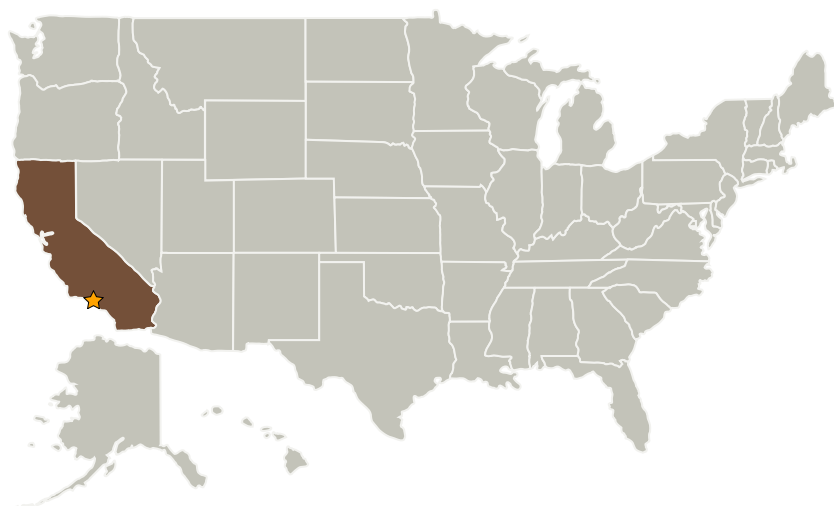
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destination	3

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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory (JPL)	Lead Organization	NASA Center	Pasadena, California

### Primary U.S. Work Locations

California

## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

### Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

## Project Management

### Program Director:

Carolyn R Mercer

### Program Manager:

Haris Riris

### Principal Investigator:

Alan Kleinsasser

### Co-Investigators:

Francesco Marsili  
Peter K Day  
Karen R Piggee  
Bruce Bumble  
Mark A Lindeman  
Glenn S Orton

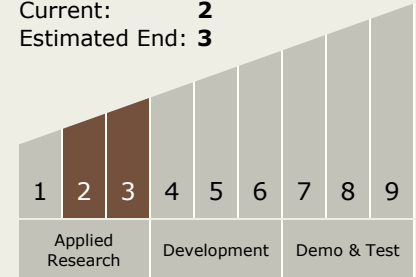
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## Technology Maturity (TRL)

Start: 2  
Current: 2  
Estimated End: 3



## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.1 Detectors and Focal Planes

## Target Destination

Others Inside the Solar System